

CLAIMS:

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent is:

- 1 1. A method for asynchronously transmitting one or more incremental database updates from a primary volume at a primary site to a remote volume at a remote site, the primary site and the remote site interconnected by at least one communication link, the method comprising the steps of:
 - 5 (a) destaging modified data to the primary volume for a current database update and updating one or more bits in a first bitmap at the primary site that indicate one or more tracks on the primary volume that are to be overwritten with the modified data;
 - 9 (b) transferring the first bitmap to a second bitmap at the primary site for indicating the modified data that is to be transmitted to the remote volume at the remote site for the current database update; and
 - 12 (c) synchronizing the primary volume at the primary site with the remote volume at the remote site for the current database update by transmitting the modified data to the remote volume as indicated by one or more bits in the second bitmap, wherein the one or more incremental database updates at the primary volume of the primary site are decoupled from transmission of the one or more incremental database updates to the remote volume at the remote site.
- 1 2. The method for asynchronously transmitting one or more incremental database updates according to Claim 1, wherein the first bitmap represents a FlashCopy bitmap and the second bitmap represents a PPRC bitmap.
- 1 3. The method for asynchronously transmitting one or more incremental database updates according to Claim 1, the method further comprising a

3 step of flashcopying the primary volume at the primary site to a target volume at the
4 primary site for the current database update.

1 4. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 3, wherein the step of flashcopying
3 initializes the one or more bits in the FlashCopy bitmap.

1 5. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 1, the method further comprising a
3 step of flashcopying remote volume at the remote site to a target volume at the remote
4 site for the current database update.

1 6. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 1, the method further comprising a
3 step of providing an application host that is coupled to primary volume for performing
4 the one or more database updates at the primary volume.

1 7. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 1, the method further comprising a
3 step of staggering the one or more database updates during the current database
4 update.

1 8. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 1, wherein the step of staggering
3 comprises the steps of:

4 determining whether a synchronization for a previous database update
5 is complete after performing the step of destaging for the current database update; and
6 waiting for the synchronization of the previous database update to
7 complete before the step of transferring the first bitmap to the second bitmap for the
8 current database update.

1 9. The method for asynchronously transmitting one or more
2 incremental database updates according to claim 8, the step of staggering further
3 comprising a step of:
4 flashcopying the primary volume at the primary site to a secondary
5 volume at the primary site and initializing the first bitmap for a next database update
6 after the transferring step for the current database update; and
7 waiting for the next database update after the synchronizing step for the
8 current database update.

1 10. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 5, the method further comprising a
3 step of establishing a peer to peer remote copy session between the target volume at
4 the primary site and the remote volume at the remote site for physically transmitting
5 the modified data over the at least one communication link to the remote volume for
6 the current database update.

1 11. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 3, the method further comprising a
3 step of providing a controller at the primary site for managing access to both the
4 primary volume and the target volume at the primary site.

1 12. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 5, the method further comprising a
3 step of providing a controller at the remote site for managing access to the remote
4 volume and a target volume at the remote site.

1 13. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 1, the method further comprising the
3 steps of:

4 initializing the first bitmap to indicate that all data on the primary
5 volume at the primary site is to be copied to the remote volume at the remote site;
6 synchronizing the data from the primary volume at the primary site to
7 the remote volume at the remote site; and
8 flashcopying the remote volume at the remote site to a target volume at
9 the remote site.

1 14. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 13, the method further comprising a
3 step of providing a recovery host that is coupled to the target volume at the remote site
4 for recovering from a failure of the primary site by providing access the transmitted
5 incremental database updates from the primary site.

1 15. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 1, the method further comprising a
3 step of automatically initiating the incremental data update.

1 16. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 1, the step of destaging further
3 comprising the steps of:
4 inspecting the one or more bits of the first bitmap at the primary site to
5 determine whether a target volume at the primary site includes the modified data; and
6 copying data that is to be overwritten with modified data to the target
7 volume at the primary site if the first bitmap indicates that the target volume does not
8 include the data to be overwritten.

1 17. The method for asynchronously transmitting one or more
2 incremental database updates according to Claim 1, wherein the at least one
3 communication link is selected form the group consisting of: a channel link; a T1/T3
4 link; a Fibre channel; and an ESCON link.

1 18. A system for asynchronously transmitting one or more incremental
2 database updates from a primary volume at a primary site to a remote volume at a
3 remote site, the primary site and the remote site interconnected by at least one
4 communication link, the system comprising:
5 a local controller associated with the primary site comprising:
6 a means for destaging modified data to the primary volume for a
7 current database update and updating one or more bits in a first bitmap at the primary
8 site that indicate one or more tracks on the primary volume that are to be overwritten
9 with the modified data;
10 a means for transferring the first bitmap to a second bitmap at the
11 primary site for indicating the modified data that is to be transmitted to the remote
12 volume at the remote site for the current database update; and
13 a means for synchronizing the primary volume at the primary site with
14 the remote volume at the remote site for the current database update by transmitting
15 the modified data to the remote volume as indicated by one or more bits in the second
16 bitmap, wherein the one or more incremental database updates at the primary volume
17 of the primary site are decoupled from transmission of the one or more incremental
18 database updates to the remote volume at the remote site.

1 19. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 18, wherein the first bitmap
3 represents a FlashCopy bitmap and the second bitmap represents a PPRC bitmap.

1 20. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 18, the system further comprising a
3 means of flashcopying the primary volume at the primary site to a target volume at the
4 primary site for the current database update.

1 21. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 20, wherein the means for
3 flashcopying initializes the one or more bits in the first bitmap.

1 22. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 18, the system further comprising a
3 remote controller associated with the remote site comprising a means for flashcopying
4 the remote volume at the remote site to a target volume at the remote site for the
5 current database update.

1 23. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 18, the system further comprising an
3 application host that is coupled to primary volume for performing the one or more
4 database updates at the primary volume.

1 24. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 18, the system further comprising a
3 means for staggering the one or more database updates during the current database
4 update.

1 25. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 18, wherein the means for staggering
3 comprises:

4 means for determining whether a synchronization for a previous
5 database update is complete after performing the step of destaging for the current
6 database update; and

7 means for waiting for the synchronization of the previous database
8 update to complete before the step of transferring the first bitmap to the second bitmap
9 for the current database update.

1 26. The system for asynchronously transmitting one or more
2 incremental database updates according to claim 25, the means for staggering further
3 comprising:

4 means for flashcopying the primary volume at the primary site to a
5 secondary volume at the primary site and initializing the first bitmap for a next
6 database update after the transferring step for the current database update; and
7 means for waiting for the next database update after the synchronizing
8 step for the current database update.

1 27. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 22, the controller further comprising
3 a peer to peer remote copy adapter for establishing a peer to peer remote copy session
4 between the target volume at the primary site and the remote volume at the remote site
5 to physically transmit the modified data over the at least one communication link to
6 the remote volume for the current database update.

1 28. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 18, wherein the controller at the
3 primary site comprises a device adapter for managing access to both the primary
4 volume and the target volume at the primary site.

1 29. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 22, wherein the remote controller at
3 the remote site comprises a device adapter for managing access to the remote volume
4 and a target volume at the remote site.

1 30. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 18, wherein the local controller
3 associated with the primary site further comprises:

4 means for initializing the first bitmap to indicate that all data on the
5 primary volume at the primary site is to be copied to the remote volume at the remote
6 site;

7 means for synchronizing the data from the primary volume at the
8 primary site to the remote volume at the remote site; and

9 means for flashcopying the remote volume at the remote site to a target
10 volume at the remote site.

1 31. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 30, the system further comprising a
3 recovery host that is coupled to the target volume at the remote site for recovering
4 from a failure of the primary site by providing access the transmitted incremental
5 database updates from the primary site.

1 32. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 18, the system further comprising a
3 means for automatically initiating the incremental data update.

1 33. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 18, wherein the destaging further
3 compromises:

4 means for inspecting the one or more bits of the first bitmap at the
5 primary site to determine whether a target volume at the primary site includes the
6 modified data; and

7 means for copying data that is to be overwritten with modified data to
8 the target volume at the primary site if the first bitmap indicates that the target volume
9 does not include the data to be overwritten.

1 34. The system for asynchronously transmitting one or more
2 incremental database updates according to Claim 18, wherein the at least one

1 communication link is selected from the group consisting of: a channel link; a T1/T3
2 link; a Fibre channel; and an ESCON link.

1 35. A controller associated with a primary site for asynchronously
2 transmitting one or more incremental database updates from a primary volume at the
3 primary site to a remote volume at a remote site, the primary site and the remote site
4 interconnected by at least one communication link, the controller comprising:

5 means for destaging modified data to the primary volume for a current
6 database update and updating one or more bits in a first bitmap at the primary site that
7 indicate one or more tracks on the primary volume that are to be overwritten with the
8 modified data;

9 means for transferring the first bitmap to a second bitmap at the
10 primary site for indicating the modified data that is to be transmitted to the remote
11 volume at the remote site for the current database update; and

12 means for synchronizing the primary volume at the primary site with
13 the remote volume at the remote site for the current database update by transmitting
14 the modified data to the remote volume as indicated by one or more bits in the second
15 bitmap, wherein the one or more incremental database updates at the primary volume
16 of the primary site are decoupled from transmission of the one or more incremental
17 database updates to the remote volume at the remote site.

1 36. A program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates from a primary volume at a
4 primary site to a remote volume at a remote site, the primary site and the remote site
5 interconnected by at least one communication link, the method comprising the steps
6 of:

7 (a) destaging modified data to the primary volume for a current
8 database update and updating one or more bits in a first bitmap at the primary site that

1 indicate one or more tracks on the primary volume that are to be overwritten with the
2 modified data;

3 (b) transferring the first bitmap to a second bitmap at the primary site
4 for indicating the modified data that is to be transmitted to the remote volume at the
5 remote site for the current database update; and

6 (c) synchronizing the primary volume at the primary site with the
7 remote volume at the remote site for the current database update by transmitting the
8 modified data to the remote volume as indicated by one or more bits in the second
9 bitmap, wherein the one or more incremental database updates at the primary volume
10 of the primary site are decoupled from transmission of the one or more incremental
11 database updates to the remote volume at the remote site.

1 37. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 36, wherein
4 the first bitmap represents a FlashCopy bitmap and the second bitmap represents a
5 PPRC bitmap.

1 38. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 36, the
4 method further comprising a step of flashcopying the primary volume at the primary
5 site to a target volume at the primary site for the current database update.

1 39. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 38, wherein
4 the step of flashcopying initializes the one or more bits in the first bitmap.

1 40. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 36, the
4 method further comprising a step of flashcopying remote volume at the remote site to
5 a target volume at the remote site for the current database update.

1 41. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 36, the
4 method further comprising a step of providing an application host that is coupled to
5 primary volume for performing the one or more database updates at the primary
6 volume.

1 42. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 36, the
4 method further comprising a step of staggering the one or more database updates
5 during the current database update.

1 43. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 36, wherein
4 the step of staggering comprises the steps of:

5 determining whether a synchronization for a previous database update
6 is complete after performing the step of destaging for the current database update; and
7 waiting for the synchronization of the previous database update to
8 complete before the step of transferring the first bitmap to the second bitmap for the
9 current database update.

1 44. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 43, the step
4 of staggering further comprising a step of:

5 flashcopying the primary volume at the primary site to a secondary
6 volume at the primary site and initializing the first bitmap for a next database update
7 after the transferring step for the current database update; and

8 waiting for the next database update after the synchronizing step for the
9 current database update.

1 45. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 40, the
4 method further comprising a step of establishing a peer to peer remote copy session
5 between the target volume at the primary site and the remote volume at the remote site
6 for physically transmitting the modified data over the at least one communication link
7 to the remote volume for the current database update.

1 46. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 38, the
4 method further comprising a step of providing a controller at the primary site for
5 managing access to both the primary volume and the target volume at the primary site.

1 47. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 40, the
4 method further comprising a step of providing a controller at the remote site for
5 managing access to the remote volume and a target volume at the remote site.

1 48. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 36, the
4 method further comprising the steps of:

5 initializing the first bitmap to indicate that all data on the primary
6 volume at the primary site is to be copied to the remote volume at the remote site;

7 synchronizing the data from the primary volume at the primary site to
8 the remote volume at the remote site; and

9 flashcopying the remote volume at the remote site to a target volume at
10 the remote site.

1 49. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 48, the
4 method further comprising a step of providing a recovery host that is coupled to the
5 target volume at the remote site for recovering from a failure of the primary site by
6 providing access the transmitted incremental database updates from the primary site.

1 50. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 36, the
4 method further comprising a step of automatically initiating the incremental data
5 update.

1 51. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 36, the step
4 of destaging further comprising the steps of:

5 inspecting the one or more bits of the first bitmap at the primary site to
6 determine whether a target volume at the primary site includes the modified data; and

7 copying data that is to be overwritten with modified data to the target
8 volume at the primary site if the first bitmap indicates that the target volume does not
9 include the data to be overwritten.

1 52. The program storage device, tangibly embodying a program of
2 instructions executable by a machine to perform a method for asynchronously
3 transmitting one or more incremental database updates according to Claim 36, wherein
4 the at least one communication link is selected from the group consisting of: a channel
5 link; a T1/T3 link; a Fibre channel; and an ESCON link

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